

Research on the Influence of Cluster Innovation on the Upgrading of Cluster Enterprises under the Background of “Internet +”—Take Zhejiang Pharmaceutical Chemicals Cluster for example

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Abstract. With the introduction of the “Internet +” action, the upgrading of traditional industrial clusters has ushered in new opportunities and challenges. The enhancement of the cluster enterprise's innovation advantage can promote the upgrading, and the innovation advantage can be reflected in the enhancement of the enterprise's learning ability. This paper conducted a questionnaire survey on Zhejiang pharmaceutical chemicals cluster. Under the background of “Internet +”, the empirical analysis found that knowledge transformation ability and knowledge application ability have a positive impact on the cluster enterprises' upgrading. The knowledge acquisition ability can only promote the product upgrading of the cluster, and it has no effect on the process upgrading. Organizational philosophy and team support have a positive regulatory role in the relationship between cluster innovation and cluster enterprises' upgrading, while supervisor support has no significant impact.

Introduction

In the new era, China's economic development has entered a new normal, accompanied with new opportunities and challenges. After a long period of exploration and development, China's industrial cluster has become an important component of the national economy. While improving regional industrial competitiveness, it has also promoted the development of China's foreign economy^[1]. At present, the production development of industrial clusters in China are still at the middle and low end of the global value chain, and the lack of innovation capability is the problem^[2]. The development of cluster enterprises is affected by market shrinkage, information acquisition lag, insufficient innovation and structural risks. The government work report in 2018 once again discussed the “Internet +” action plan. Premier Ke-qiang LI pointed out that it is necessary to pay attention to the emerging industry cluster, become bigger and stronger, run large data development, and promote the application of “Internet +” in many fields. Measures such as “Internet + e-government service” and one-stop service are put forward. Under the new normal, the application of Internet information and communication technology in multiple fields brings new opportunities for economic and social development, while “Internet +” provides information power for cluster enterprises to jump to the middle and high-end level. In the face of internal and external barriers and the encouragement and support of government policies, the realization of enterprise transformation and upgrading is the current choice for the development of cluster enterprises, as well as the necessary choice to maintain the sustainable and healthy development of enterprises. Under the new situation, the integration and innovation of “Internet + cluster enterprises” becomes particularly important. This kind of integration and innovation will give new information impetus and direction for the upgrading and growth of cluster enterprises.

The discussions on industrial cluster upgrading by domestic and foreign scholars mostly touch on innovation-driven and global value chain. From the perspective of “innovation-driven”, the forms of upgrading include product, function, process and department. The impact of various innovative measures on upgrading and the corresponding upgrading mechanism are mainly discussed. From the perspective of “value chain”, industrial upgrading is divided into process, product, function and chain, and the related strategies of enterprise upgrading are mainly discussed. With the proposal of “Internet +” strategy in 2015, many scholars began to focus on the relationship between industrial cluster upgrading and “Internet +”. The research of Zhou LIU gives the general path of Internet upgrading of industrial clusters, as well as two main modes of e-commerce driving and industry 4.0. Nai-ye ZHANG discussed the mechanism of the Internet in industrial cluster upgrading under the background of “Internet +”. Other scholars have studied the current situation and

path of enterprise upgrading. In a comprehensive view, previous research results have made great contributions. However, most scholars focus on the overall level, and seldom discuss the upgrading mechanism from the micro level of enterprises in the cluster.

The micro level of cluster upgrading is the enterprises within the cluster. Therefore, this paper focuses on the enterprise level to explore. The power source of cluster upgrading comes from the innovation behavior of the core enterprises within the cluster, the transmission source comes from the knowledge behavior of the cluster enterprises, and the inner source of cluster upgrading is based on the innovation transmission of the core enterprises. The enhancement of innovation advantage of cluster enterprises can promote the upgrading of enterprises, which can be reflected in the enhancement of learning ability. The government work report pointed out that a new emerging industrial cluster should be constructed by innovation, then play its key role in pushing the cluster to the middle and high end and providing impetus for the upgrading of traditional industrial clusters. The key factors for an enterprise to survive in a competitive environment lie in how to extract the required knowledge from numerous external and internal information, and how to manage knowledge acquisition, production, communication and enterprise upgrading ability. In this era of knowledge economy, knowledge is the basis for innovation, and resources are the basis for the upgrading of enterprise clusters. Organizations need to learn to absorb knowledge resources to realize innovation. Therefore, in the context of “Internet plus”, this paper, from the perspective of global value chain, uses organizational learning ability to demonstrate cluster innovation, and discusses the influence mechanism of cluster innovation on the upgrading of cluster enterprises, then provides reference and inspiration for the upgrading of China's cluster enterprises.

Theoretical Framework and Research Hypothesis

Cluster Innovation and Cluster Enterprise Upgrading

Under the background of “Internet +”, this paper studies the upgrading of cluster enterprises from the perspective of global value chain and in combination with the current situation of Zhejiang pharmaceutical and chemical industrial cluster enterprises. No matter from which perspective, innovation ability is the driving force of cluster enterprise upgrade. The ability to innovate is very important for business because it has the ability to inspire new processes, new products or new ideas in the organization. And organizational learning has a significant positive impact on organizational innovation. Enterprises with greater commitment to organizational learning can create more outstanding organizational innovation. Organizational network can gain competitiveness through organizational learning and innovation process. Learning and innovation is an important way for an enterprise to develop its dynamic ability, which is a key factor for an enterprise to acquire and maintain its competitive advantage in a dynamic environment. Chinese enterprises should learn to improve their dynamic capabilities and competitive advantages through knowledge learning and innovation. Knowledge is difficult to create and transfer in the absence of social interaction and labor flow, which constitutes the most important source of learning and sustainable competitive advantage in the knowledge economy. Organizations need to learn to change and stabilize their knowledge inventory to meet environmental requirements, and companies that can use knowledge as a source of learning are more likely to generate strong innovation capabilities. Knowledge is the resource foundation of organizational growth. Organizational learning comes from the acquisition of knowledge, and learning is an important predictive factor of innovation. Innovation can be regarded as an informal learning process, and the improvement of learning ability reflects innovation.

The most representative concept of organizational learning is given by Argyris and Schon (1978) in their works, who believe that “organizational learning is to promote long-term efficiency and survival and development, while in the practice process of responding to environmental changes, various adjustment activities of its fundamental belief, attitude and behavior, and structural arrangement are performed; These adjustment activities are achieved through formal and informal human interaction. Innovation ability is the driving force of cluster enterprise upgrading. Organizational learning has a positive impact on organizational innovation, and enterprises with greater commitment to organizational learning can create more outstanding organizational innovation. With the development of the times and the enrichment of research results, organizational learning is given a new concept interpretation. Based on the previous research results, this paper gives that organizational learning is the ability to acquire knowledge from the outside, transform knowledge, apply knowledge and share knowledge. These behaviors are affected by the external environment and internal needs of the organization. Li-xin ZHANG (2006) has verified the applicability of

the western four-dimensional model of organizational learning ability to Chinese enterprises. Combining with Guo-quan CHEN's division of organizational learning ability (2017), this paper extracted three measuring dimensions, knowledge acquisition ability, knowledge transformation ability and knowledge application ability.

The improvement of organizational learning ability can test the innovation level of enterprises. Therefore, this paper tests cluster innovation variables by organizing learning ability, and the dimensions include knowledge acquisition, knowledge transformation and knowledge application. Knowledge acquisition ability refers to the ability to acquire knowledge from the dynamic changing external environment according to enterprise goals or requirements. Global competition forces companies to rethink how they can gain knowledge of new organizations. New knowledge provides the foundation for new skills that can lead to competitive success. Creating new knowledge is a major challenge for all organizations. The new knowledge acquisition and sharing stage is the beginning of the whole knowledge creation process of the organization. Knowledge provides the ability to organize and act, and new knowledge provides the ability to update the organization. Knowledge is the inexhaustible power of the organization to retain the upper hand in the competition. Only by constantly developing and acquiring external knowledge can the enterprise improve its innovation performance. The main problem in knowledge acquisition is to identify different structures and characteristics of external knowledge and match them with internal knowledge. Acquiring knowledge from dynamic and changing external environment can interact with internal knowledge sharing to stimulate innovation. The technological knowledge base of the enterprise is the foundation of the innovation of internal products and processes. However, technical knowledge is not accumulated solely through an internal learning process. More and more companies are turning to external sources of technology supply chains to acquire the technical knowledge they need to introduce product and process innovation. Therefore, successful organization and execution of partnerships with external "technology sources" organizations is often critical to competitive success in a technology dynamic environment. In general, the knowledge breadth and depth of knowledge acquisition and knowledge innovation depends on the influence of the market share, to obtain knowledge of the company are more likely to have internal knowledge sharing and knowledge acquirement of non-market achieve radical innovation, the company can have a deep knowledge base is more ability through market knowledge acquisition rather than internal knowledge sharing in order to develop innovation. Knowledge acquisition ability has a significant impact on innovation quality. Participants with higher knowledge acquisition ability can refer to more knowledge to enhance organizational innovation and stimulate enterprise transformation and growth. LI P's research indicates that the acquisition ability of literature knowledge has a positive impact on enterprise innovation^[3]. Knowledge acquisition can promote enterprise innovation behavior, it can also through new product development, technology unique to influence the competitive advantage of knowledge development, such as face-to-face communication between members of the enterprise internal and external can strengthen the knowledge acquisition and sharing, most employees prefer to acquire knowledge from team members, and share knowledge with them. This means that greater familiarity and collaboration among team members can help increase productivity. Enterprises should encourage their employees to participate in professional communities and internal communication activities to gain new knowledge. Knowledge gained through these channels will contribute to the sharing of innovation and development knowledge within the organization. Promoting knowledge acquisition through network relations between internal and external members can promote cluster collaborative innovation and bring innovation impetus to enterprise upgrading and growth. Therefore, the following hypotheses are proposed:

H1a: Knowledge acquisition ability can effectively promote the process upgrading of cluster enterprises.

H1b: Knowledge acquisition ability can effectively promote the product upgrading of cluster enterprises.

Knowledge transformation ability refers to the ability to transform existing knowledge or acquired knowledge in some way to integrate and apply it to the internal network of the organization. In the new era of "Internet plus," scientific and non-scientific knowledge is being transformed at a tremendous rate through digital media. The rapid development of information society provides complex space for knowledge transformation and scientific dynamic mechanism. Dynamic capabilities help to integrate and build an organization, which has the ability to rearrange internal and external knowledge, adapt to a constantly changing environment, and control the sources of competitive advantage. In addition, advances in information technology have driven changes in the competitive environment and business model. Traditional competitive forces cannot support the analysis of complex industrial environment, so it is necessary to establish knowledge integration ability and knowledge transformation ability to improve competitive advantage. Based on the obsolescence of existing knowledge resources, enterprises have to reprocess them in

order to launch new products. Knowledge and learning ability are the key success factors of enterprise competitive advantage. The knowledge base of an enterprise determines its competitive advantage. The core of enterprise knowledge management is to transform knowledge into organizational knowledge independent of specific individuals. The basic way of knowledge transformation is knowledge exchange. The most basic aspect of knowledge is that it is the result of sharing experiences through interaction. Social interaction is the core of knowledge transfer and learning. Knowledge transfer may occur when internal and external members of an enterprise interact with each other. Trust and communication among members can improve knowledge transfer, which can improve individual innovation ability. Therefore, knowledge transformation is a social process of internal and external interaction. Knowledge from both internal and external sources should be transferred to all levels of the organization. The creation of knowledge comes from the fusion of knowledge and related resources. Understanding the knowledge transformation process can help enterprises improve their organizational structure^[4]. In the research of ALGHARIBEH K M, it is mentioned that in order to establish knowledge assets, knowledge sharing needs to be carried out in the organization, and knowledge transformation is an important part of knowledge sharing. While reconstructing existing knowledge, we use knowledge transformation to construct new knowledge so that internal innovation capacity can converge in all links of value chain, providing innovation impetus for upgrading. Therefore, enterprises can rely on open innovation to promote knowledge transformation, which is beneficial to the construction of knowledge assets of enterprises, so as to apply the products and technological processes of innovative enterprises. At the same time, innovation and knowledge are the driving force of competitiveness and growth, and knowledge transformation and independent innovation are the catalysts for enterprise transformation and growth. Knowledge transformation can promote the development of enterprises by encouraging independent innovation. Therefore, the following hypotheses are proposed:

H2a: Knowledge transformation ability can effectively promote the process upgrading of cluster enterprises.

H2b: Knowledge transformation ability can effectively promote the product upgrading of cluster enterprises;

Knowledge application ability refers to the ability of an enterprise to make timely response to environmental changes and integrate new knowledge and technology into new product development or process. In the current industrial context, enterprises regard knowledge as an important resource and strategy for innovation, and innovation is increasingly seen as the result of the interactive process of knowledge generation and knowledge application. To cope with the ever-changing business environment, enterprises need to open their organizational boundaries to utilize external knowledge resources. Then the enterprise will face the challenge of balancing external dynamic knowledge and internal mature knowledge to obtain benefits from external knowledge. In general, enterprises with high technology knowledge stock have higher opportunity cost of further opening the R&D boundary of the organization, so as to better realize the open innovation model. From the knowledge-based point of view, the enterprise's innovation performance is the function of the enterprise's internal and external knowledge utilization and reorganization. Companies can create new products from the inside and outside through different connections through knowledge utilization and reorganization. But companies don't always succeed in creating new products while leveraging and reorganizing unique, non-copycat knowledge. Successful innovation requires organizations to promote the use of Internet information technology and knowledge among different roles in the innovation operation system. Therefore, senior managers should share information with the leaders of each link of the production value chain and let them actively use appropriate external knowledge and technology to encourage the success of new products. The study of M Song shows that knowledge application is crucial to the development of successful new products, and knowledge application is the source of knowledge and technology of new products and new processes. Knowledge is the engine that drives innovation. In a highly competitive market environment, enterprises need to have the ability to apply potential knowledge appropriately if they want to find the competitive advantage of product quality. In conclusion, it can be considered that the ability of knowledge application has an impact on the upgrading of cluster enterprises. Therefore, the following hypotheses are proposed:

H3a: Knowledge application ability can effectively promote the process upgrading of cluster enterprises.

H3b: Knowledge application ability can effectively promote the product upgrading of cluster enterprises;

Regulating Effect of Organizational Innovation Atmosphere

In 2016, the Chinese government issued The Outline of National Innovation-Driven Development Strategy, which aims to adjust China's economic growth momentum from the driving factor to the innovation-driven

factor and promote enterprise upgrading^[5]. The research of XB Pei et al. also proposed the path of enterprise upgrading driven by innovation^[6]. Organizational innovation atmosphere is one of the major regulatory indicators of organizational innovation^[7], which can effectively promote the innovation behaviors of the members in the organization, which will have a corresponding impact on the relationship between organizational learning ability and the upgrading of cluster enterprises. Under the current background, Chinese enterprises are in the process of upgrading industrial structure and new economic growth, so it is of special significance to fully develop and promote industrial development. If the enterprise wants to maintain the successful state all the time, the innovation idea is very necessary, positive organization innovation atmosphere is also very necessary. Organizational atmosphere, participatory management and innovation incentive mechanism are considered as the core requirements for managers to organize and lead organizational innovation. Objectively, the organizational innovation atmosphere is the employee's perception of the objective phenomenon of organizational environment innovation. Subjectively, the organizational innovation atmosphere is the psychological perception of employees to support organizational innovation or promote innovation. Organizational innovation is an important part of enterprise innovation and the foundation and guarantee of the whole enterprise innovation activities. Given that one of the creativity factors in an organization is its atmosphere, people are more motivated to innovate when there is a good atmosphere. Studies have shown that there are significant, direct and positive effects between the individual, group and organizational level of organizational innovation, among which the individual's innovative management ability, the innovative group atmosphere and the knowledge orientation of organizational innovation are the most important to the organizational efficiency. Based on the organizational innovation atmosphere scale designed by scholar Lliu Yun and Ai-jing Ran, this paper measures and discusses the three dimensions of organizational concept, team support and supervisor support. Organizational concept is an important content of organizational culture, which refers to the culture, consciousness or spirit that encourages innovation in the organization. Team support refers to the communication, trust and help among the members within the organization. Supervisor support means that the supervisor personally supports the organization member's new idea or gives care through some means. Therefore, the following hypotheses are proposed:

H4a: Organizational philosophy can positively regulate the relationship between organizational learning ability and the upgrading of cluster enterprises.

H4b: Team support can positively regulate the relationship between organizational learning ability and the upgrading of cluster enterprises.

H4c: Supervisor support can positively regulate the relationship between organizational learning ability and the upgrading of cluster enterprises.

In addition, this paper has sorted out the relevant attributes of cluster enterprises from the previous studies, such as enterprise nature, operation years of enterprise, and business category. Many studies have selected the basic attributes of cluster enterprises as the control variables. The research of Jian-zhuang Zheng et al (2017) has shown that enterprise size and category have a positive and significant impact on knowledge acquisition. Chun-pei LIN et al. (2017) demonstrated that enterprise scale, operation years of enterprise and categories have a weak explanatory power for innovation changes. In this paper, three variables are selected: operation years of enterprise, enterprise scale and enterprise nature. Tang believes that knowledge acquisition is irrelevant to enterprise scale but has a significant relationship with the years and nature of enterprises^[8]. Therefore, this paper believes that these characteristics of cluster enterprises can influence enterprise upgrading to a certain extent. Therefore, the following hypotheses are proposed:

H5a: The enterprise scale can positively influence the upgrading of cluster enterprises;

H5b: The operation years of enterprise can positively influence the upgrading of cluster enterprises;

H5c: The enterprise nature can positively influence the upgrading of cluster enterprises.

Test and Results

Variable Measurement and Study Samples

This paper uses organizational learning ability to measure the cluster innovation, including three dimensions: knowledge acquisition ability, knowledge transformation ability and knowledge application ability. Mainly based on Li-xin ZHANG's scale (2006), combining with Guo-quan CHEN's division of organizational learning ability (2017), this paper designed 13 questions to measure the three dimensions; Based on Sheng-hua JIA et al. (2008) cluster enterprise upgrading scale, combining with the research of Yun SONG et

al. (2017) and the actual situation of this research cluster, 8 items were designed to measure product upgrading and process upgrading. According to the organizational innovation atmosphere scale of Yun LIU et al. (2009) and Ai-jing RAN et al. (2017), organizational philosophy, team support and supervisor support were extracted for measurement and research. In addition, this paper chooses three dimensions as control variables: the operation years of enterprise, enterprise scale and enterprise nature. The operation years of cluster enterprises is calculated from the establishment of the enterprise to the research year. The enterprise scale is mainly determined on the employee numbers, annual sales volume and total assets. This paper divides enterprise natures into state-owned or controlled enterprises, private joint-stock enterprises, private sole proprietorship, foreign enterprises, collective enterprises and others. This paper mainly selects 207 pharmaceutical chemical cluster enterprises in Shaoxing, Ningbo, Taizhou and other places of Zhejiang for the questionnaire survey, and conducts the questionnaire survey on middle and senior managers and Internet technicians of each enterprise by means of field investigation and email exchanges.

Regression Analysis Results of Cluster Innovation and Cluster Enterprise Upgrading

In this paper, Model 1 includes independent variables (knowledge acquisition ability, knowledge transformation ability and knowledge application ability) and explained variables (process upgrading of cluster enterprises) to verify the impact of cluster innovation on process upgrading of cluster enterprises. Model 2 includes three measurement variables of organizational learning ability and product upgrading of cluster enterprises to investigate the impact of cluster innovation on product upgrading of cluster enterprises. Model 1 and Model 2 are 0.242 and 0.314 respectively, which indicates that the three variables of organizational learning ability have a good predictive effect on process upgrading. In Model 1, the regression coefficients of knowledge transformation ability and knowledge application ability were respectively 0.220 and 0.254, both of which were significant at the level of 0.05. The regression coefficient of knowledge acquisition ability has not reached the significance level. It can be seen from this that the higher the knowledge transformation ability and knowledge application ability of cluster enterprises, the more positive the impact of enterprise process upgrading. Therefore, the hypotheses of H2a and H3a are verified and the H1a is overruled. In Model 2, the regression coefficients of the three measurement variables of organizational learning ability were significant at the level of 0.05. Therefore, it can be concluded that the stronger the knowledge acquisition ability, the knowledge transformation ability and the knowledge application ability of the cluster enterprises, the more the cluster innovation advantage can be created, and the cluster enterprise product upgrading can be carried out more actively. Thus, the hypotheses of H1b, H2b and H3b are verified.

Regression Analysis Results of Organizational Learning Atmosphere

Model 3, Model 4 and Model 5 are respectively added with organizational philosophy, team support and supervisor support based on the three variables of organizational learning ability to investigate the impact of the three organizational innovation climate indicators on enterprise upgrading and its regulatory effects on cluster innovation and cluster enterprise upgrading. According to the analysis results, F values of the three models are significant at the level of 0.001, indicating that the model regression is effective. In Model 3, the regression coefficients of organizational philosophy and the interaction terms of organizational philosophy and organizational learning ability were respectively 0.332 and 0.415, reaching a significant level at the level of 0.05. Therefore, it can be concluded that the organizational philosophy has a positive impact on the enterprise upgrading, and its regulatory role in cluster innovation and cluster enterprise upgrading is also significant, which supports the hypothesis H4a. In Model 4, the regression coefficients of team support and the interaction terms of team support and organizational learning ability all reach a significant level. The results show that the positive regulatory effect of team support on enterprise upgrading are significant, and the hypothesis H4b is supported. In Model 5, the regression coefficients of supervisor support and the interaction terms of supervisor support and organizational learning ability did not reach a significant level, so H4c was rejected.

This paper adopts single factor ANOVA to analyze the three control variables of enterprise characteristics. According to the mean comparison, different enterprise scales have different impacts on enterprise upgrading, and larger enterprises have more significant impacts on enterprise upgrading. Hypothesis H5a is supported. Similarly, there are certain differences in the effect of enterprise upgrading among cluster enterprises with different operation years. The cluster enterprises with longer operation years have a better effect on enterprise upgrading, the hypothesis H5b is supported. However, there is no significant difference in the effect of different enterprise nature on enterprise upgrading, so H5c is rejected.

Conclusions

The above results provide a new direction and empirical basis for the study of cluster innovation and cluster enterprise upgrading. It also provides inspiration for the upgrading of Zhejiang pharmaceutical chemical cluster enterprises and even Chinese cluster enterprises.

(1) Accelerate the completion of the independent innovation system; Enterprises should be good at acquiring various knowledge resources from the changing external environment, so as to integrate them with the development needs or internal structures of enterprises and apply them to the actual situation of enterprises, especially the big data platform, then realize the integration of “Internet + industrial clusters”. At the same time, enterprises should pay attention to the improvement of knowledge in enterprises and departments within the cluster to achieve the goal of improving organizational learning ability. Integration and innovation should go together to promote the upgrading of cluster enterprises. The pharmaceutical chemical cluster enterprises in Zhejiang can increase exchanges and cooperation with universities and research institutions to build innovative Internet big data platform of communication, promote the sharing of the latest innovations, then to bring new ideas to enterprises. The enterprise can also develop new products, new processes and new techniques, then build independent innovation system of Zhejiang.

(2) Strive to build an intelligent cluster. According to the government work report about the “Made in China 2025” and “Internet +”, enterprises in Zhejiang can make full use of big data, cloud computing and other new technology to improve product development, production process optimization, innovation growth of the upgrading and build interconnected networks of the pharmaceutical industry, then achieve intelligent interaction between cluster enterprises.

(3) Formulate policies for the growth of the Internet industry. The integration of “Internet plus” and cluster enterprises cannot be separated from the policy support from government. Local governments should respond to the national “Internet plus” action and formulate relevant policies to encourage enterprises to innovate advanced Internet facilities. The government should reasonably improve the investment conditions for scientific and technological research, facilitate the development of enterprises on a series of advanced information technologies such as cloud computing and the Internet of Things, and promote the technological innovation of cluster enterprises. At the same time, enterprises should also focus on the most advanced technology about “Internet +” and formulate some welfare policies to attract domestic and foreign first-class Internet technology talents to accelerate the establishment of the “Internet +” talent team, then provide support for the upgrading of enterprises.

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